

30. Install by reversing these removal steps while noting the following:

- Tighten the engine mounting bolts to the torque specifications in **Table 2**.
- Apply a light coat of molybdenum disulfide grease to the splines of the output shaft and the universal joint prior to engaging these 2 parts.
- Fill the engine and the front drive case, on 4-wheel drive models, with the recommended type and quantity of oil as described in Chapter Three.
- Adjust the clutch as described in Chapter Three.

- Start the engine and check for leaks.

CYLINDER HEAD COVER AND CAMSHAFT

Refer to **Figure 16** for this procedure.

Cylinder Head Cover and Camshaft Removal

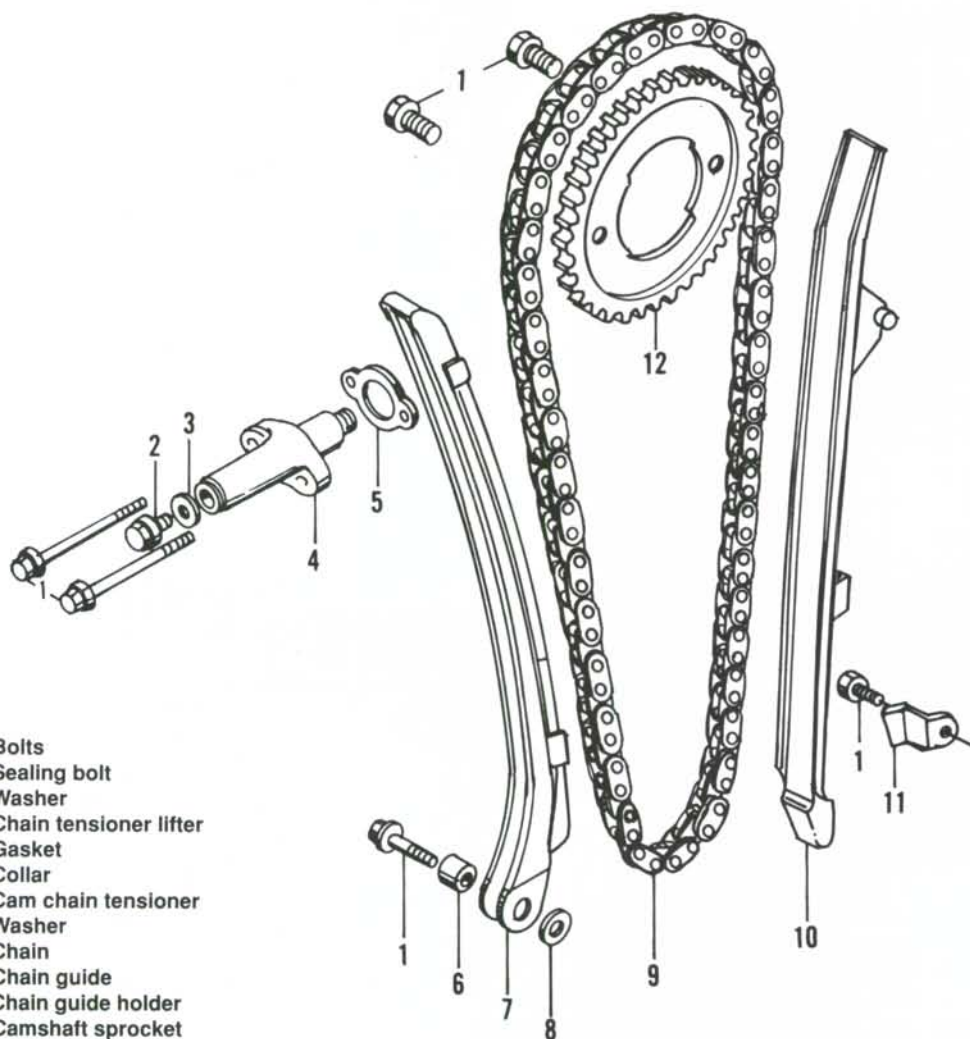
NOTE

The cylinder head cover and camshaft can be removed with the engine in the frame. The majority of this procedure is

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16

CYLINDER HEAD COVER AND CAMSHAFT



shown with the engine removed for clarity only.

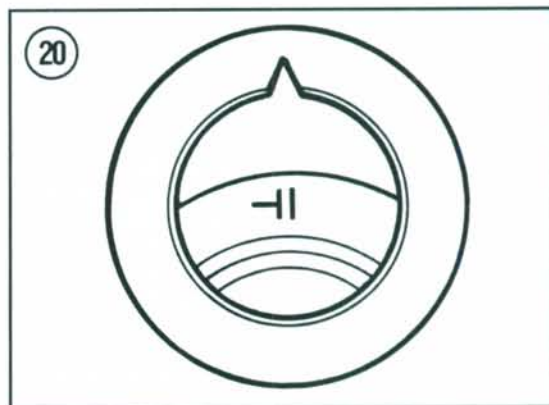
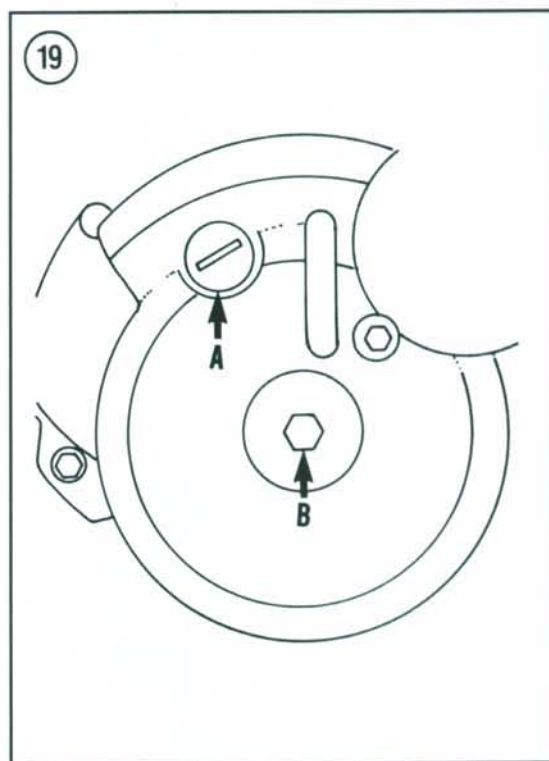
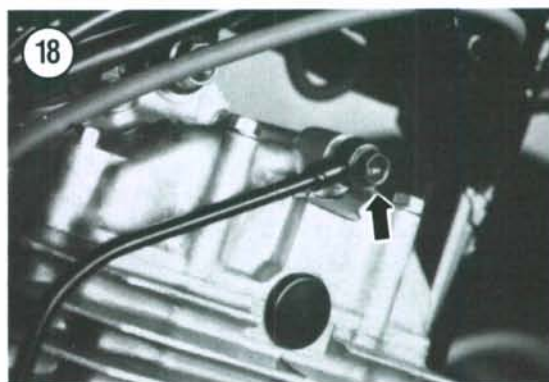
CAUTION

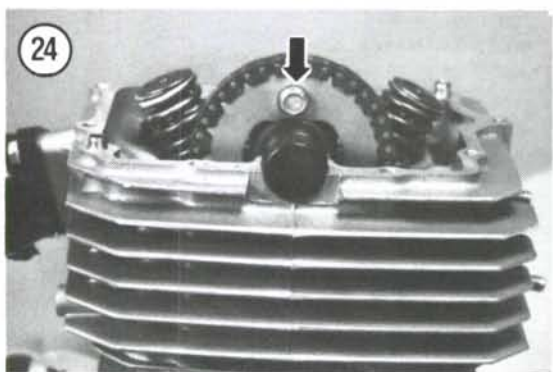
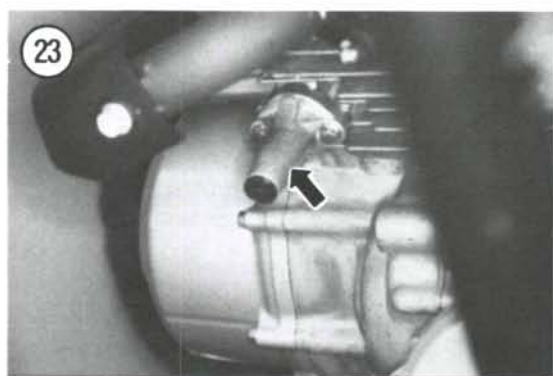
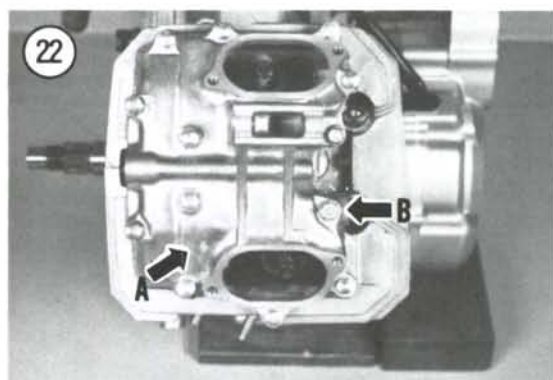
To prevent any warpage and damage, remove the cylinder head cover only when the engine is at room temperature.

1. Remove the union bolt and sealing washer (**Figure 17**) securing the external oil line to the crankcase and to the cylinder head cover (**Figure 18**).
2. Remove the bolt securing the mid-point of the oil line to the cylinder head and remove the oil line from the engine.
3. Remove the valve adjuster covers.
- 4A. On 2-wheel drive models, perform the following:
 - a. Remove the timing hole cap (A, **Figure 19**) on the left-hand crankcase cover.
 - b. Remove the crankshaft hole cap (B, **Figure 19**) on the left-hand crankcase cover.
 - c. Rotate the crankshaft *clockwise* until the "T" timing mark aligns with the fixed index mark on the crankcase cover (**Figure 20**).
- 4B. On 4-wheel drive models, perform the following:
 - a. Remove the timing inspection hole cap (A, **Figure 21**).
 - b. Remove the reduction shaft hole cap (B, **Figure 21**).
 - c. Use a 6 mm Allen wrench and rotate the reduction shaft *counterclockwise* until the "T" timing mark aligns with the fixed index mark on the crankcase cover (**Figure 20**).

NOTE

A cylinder at TDC of its compression stroke will have free play in both of its





rocker arms, indicating that both the intake and exhaust valves are closed.

5. The piston must be at top dead center (TDC) on the compression stroke.

6. With the engine timing mark on the "T," if both rocker arms are not loose; rotate the engine an additional 360° until both valves have free play.

7. Using a crisscross pattern, loosen then remove the bolts securing the cylinder head cover and remove the cover (A, **Figure 22**). Don't lose the copper washer (B, **Figure 22**) under the one bolt. This copper washer must be installed under the correct bolt to avoid an oil leak.

8. Remove the bolts securing the camshaft chain tensioner lifter (**Figure 23**) and remove the tensioner lifter and gasket.

9. Remove the spark plug (**Figure 4**). This will make it easier to rotate the engine.

10A. On 2-wheel drive models, rotate the crankshaft *clockwise* until one of the camshaft sprocket bolts is exposed.

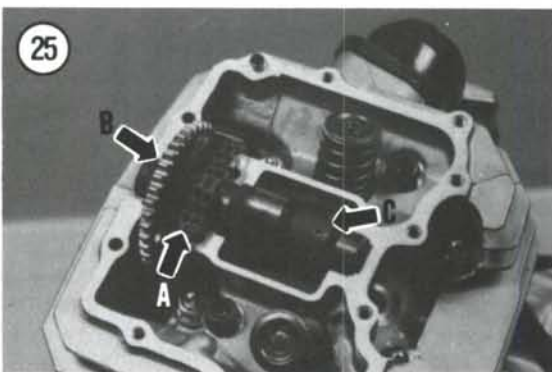
10B. On 4-wheel drive models, rotate the reduction shaft *counterclockwise* until one of the camshaft sprocket bolts is exposed.

11. Remove the exposed bolt (**Figure 24**) securing the camshaft sprocket.

12. Again rotate the engine in the correct direction (as noted in Step 10) until the other camshaft sprocket bolt is exposed. Remove that bolt.

13. Pull the camshaft chain and camshaft sprocket off the shoulder of the camshaft and let it rest on the portion of the camshaft.

14. Remove the camshaft sprocket from the camshaft chain. Rest the camshaft chain on the camshaft (A, **Figure 25**) and remove the sprocket (B, **Figure 25**).



15. Remove the camshaft (C, **Figure 25**) from the cylinder head.

16. Tie a piece of wire to the camshaft chain and tie it to an external portion of the engine to prevent the camshaft chain from falling down into the crankcase.

CAUTION

If the crankshaft must be rotated with the camshaft removed, pull up on the camshaft chain and keep it taut, make certain that the camshaft chain is properly meshed onto the crankshaft timing sprocket then rotate the crankshaft. If this step is not followed, the chain may become kinked and cause damage to the crankcases, the camshaft chain and the timing sprocket on the crankshaft.

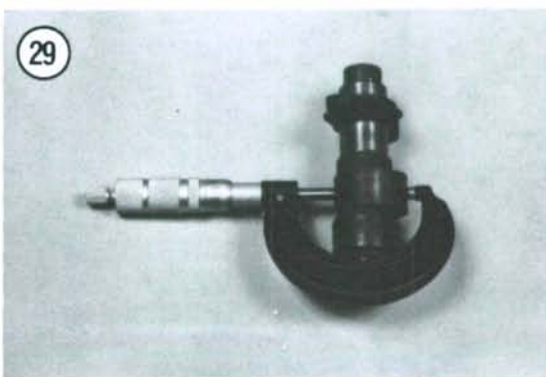
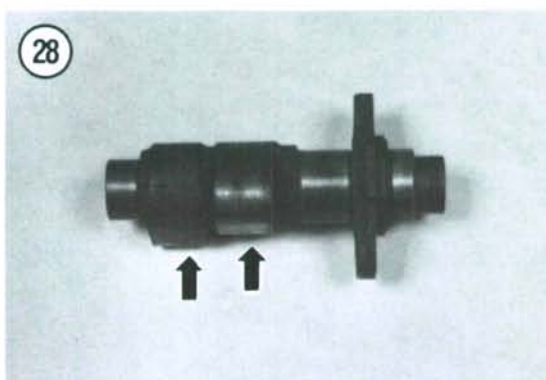
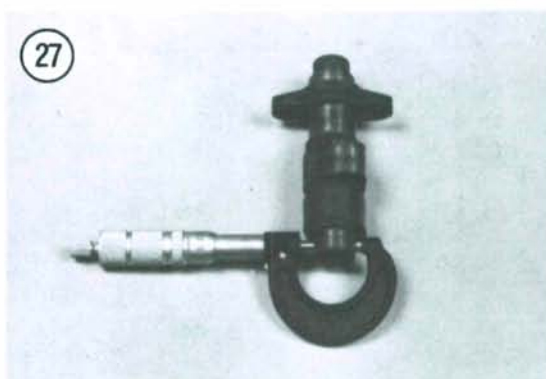
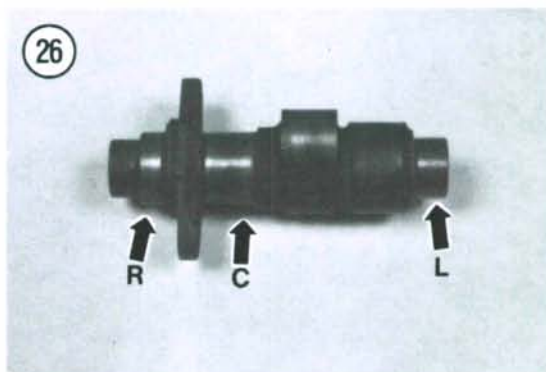
Camshaft Inspection

1. Check the camshaft bearing journals (**Figure 26**) for wear or scoring.
2. Using a micrometer, measure all 3 bearing journals as shown in **Figure 27**. Compare to dimensions listed in **Table 1**. If any dimension is worn to the service limit dimension or less the camshaft must be replaced.
3. Check the camshaft lobes (**Figure 28**) for wear or scoring. The lobes should show no signs of wear or scoring and the edges should be square. Slight damage may be removed with a silicone carbide oilstone. Use No. 100-120 grit stone initially, then polish with a No. 280-320 grit stone.

NOTE

The intake cam lobe is on the right-hand side (next to the camshaft sprocket mounting bosses) and the exhaust cam lobe is on the left-hand side.

4. Even though the lobe surface appears to be satisfactory, with no visible signs of wear, each camshaft lobe must be measured as shown in **Figure 29**. Compare to dimensions listed in **Table 1**. If either dimension is worn to the service limit dimension or less the camshaft must be replaced.
5. Check the cam bearing surfaces in the cylinder head (**Figure 30**) and cylinder head cover (**Figure 31**). The bearing surface should not be scored or excessively worn. Replace both parts as a set if either part is worn or damaged.



6. Inspect the camshaft sprocket (**Figure 32**) for wear; replace if necessary.

7. Install the cylinder head cover and install the bolts. Tighten in a crisscross pattern to the torque specification listed in **Table 2**.

8. Measure the inside diameter of the left-hand, center and right-hand bearing surface with an inside micrometer (**Figure 33**). Compare to the dimension listed in **Table 1**. If the dimension is worn to the service limit dimension or greater, replace both the cylinder head cover and cylinder head as a set.

9. Remove the bolts and remove the cylinder head cover.

Cylinder Head Cover

Disassembly/Inspection/Assembly

It is suggested that one rocker arm assembly be disassembled, inspected and then assembled to avoid the intermixing of parts. This is especially true with a well run-in engine (high mileage). Once wear patterns have developed on these parts, they should only be installed as they were removed or excessive wear may occur.

If you remove both rocker arm assemblies at the same time, mark them in sets with "I" (intake—rear of engine) or "E" (exhaust—front of engine) so they will be reinstalled in the correct location in the cylinder head cover.

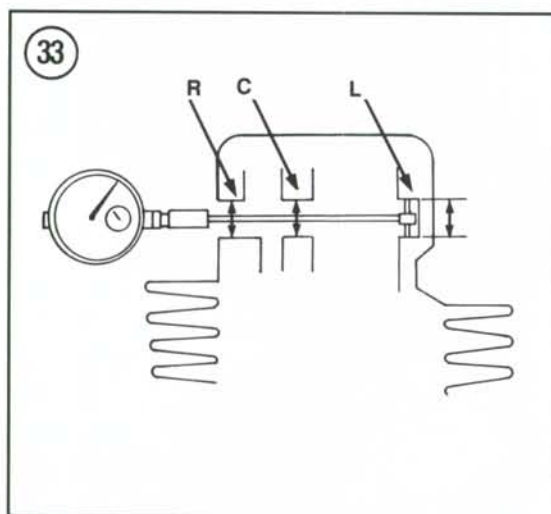
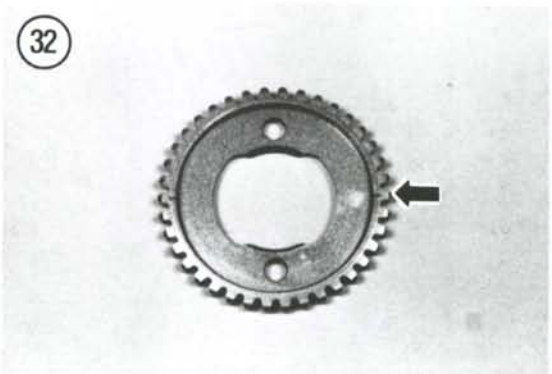
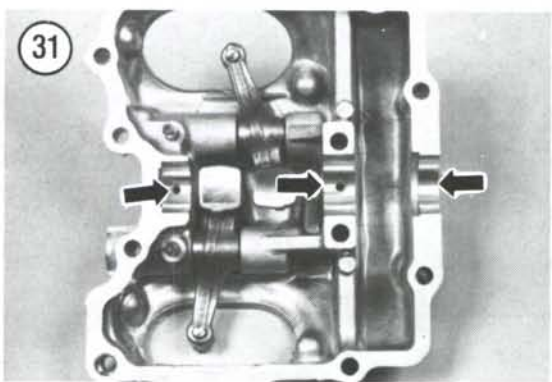
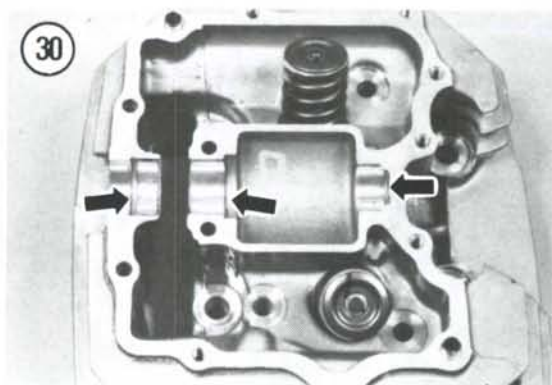
1. To remove the dowel pins (**Figure 34**) securing the rocker arm shafts perform the following:

- a. Cut a 2 mm notch (**Figure 35**) in each dowel pin with a small rotary grinder.

CAUTION

*In the following step, **do not overtighten** the vise holding the cylinder head cover. Use the vise only as a holding fixture.*

- b. Very carefully place the cylinder head cover in a vise with soft jaws.
- c. Insert a flat bladed screwdriver or drift (**Figure 35**) through the valve adjustment cover opening in the cylinder head cover and tap out



the dowel pins. Discard the dowel pins—they are not to be reused.

CAUTION

Be careful not to damage the cylinder head cover or rocker arms during the removal procedure.

NOTE

If the dowel pins are difficult to remove, apply Liquid Wrench to the base of the pins and let sit for 10-15 minutes. This may help to loosen them.

2. Inspect the rocker arm pad where it rides on the camshaft lobe and where the adjuster rides on the valve stem (**Figure 36**). If the pad is scratched or unevenly worn, inspect the camshaft lobe for scoring, chipping or flat spots. Replace the rocker arm if defective.

3. Withdraw the rocker arm shaft (**Figure 37**) and remove the rocker arm (**Figure 38**).

4. Wash all parts in cleaning solvent and thoroughly dry.

5. Measure the inside diameter of the rocker arm bore with an inside micrometer and check against the dimension listed in **Table 1**. Replace if worn to the service limit or greater.

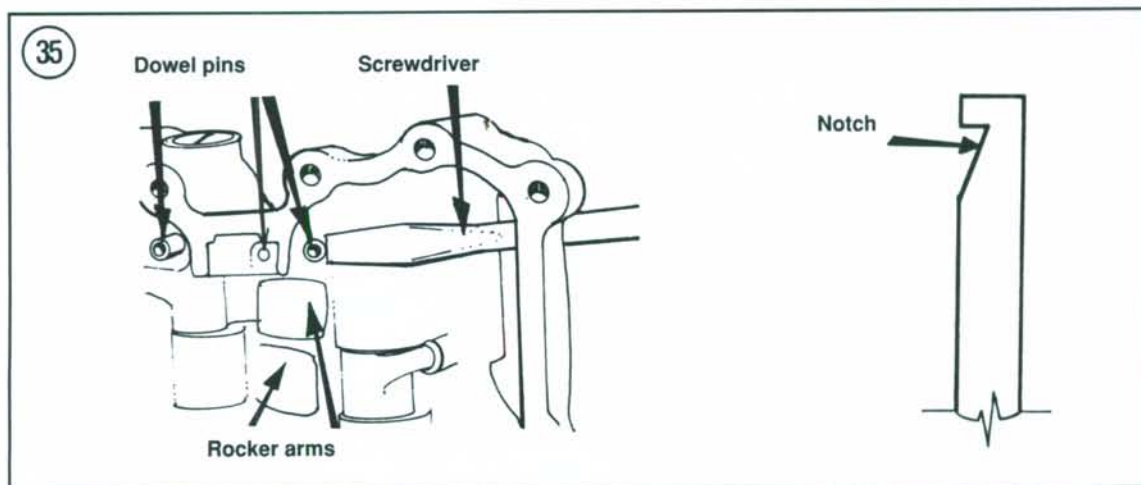
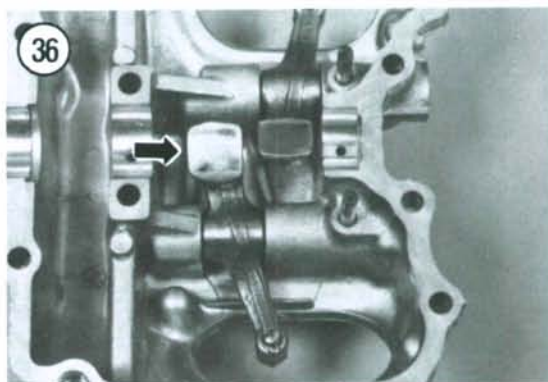
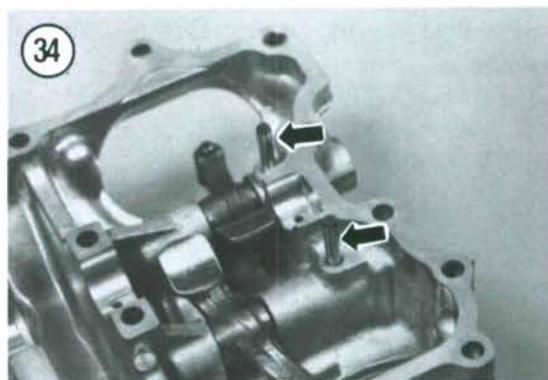
6. Inspect the rocker arm shaft for signs of wear or scoring. Measure the outside diameter with a micrometer and check against the dimension listed in **Table 1**. Replace if worn to the service limit or less.

7. Coat the rocker arm shaft and rocker arm bore with assembly oil or fresh engine oil.

8. Install a new O-ring seal on the end of the rocker arm.

9. Insert the rocker arm shaft into the cylinder head cover and position the rocker arm into the cylinder head cover.

10. Align the dowel pin hole in the rocker arm shaft with the hole in the cylinder head cover. Push the



rocker arm shaft all the way through the rocker arm until it bottoms out.

11. Using the slot on the end of the rocker arm shaft (**Figure 37**). Align the dowel pin holes and install new dowel pins. Hammer the dowel pin in with a hammer until it bottoms out. Never reuse a dowel pin that has a removal notch ground into it.

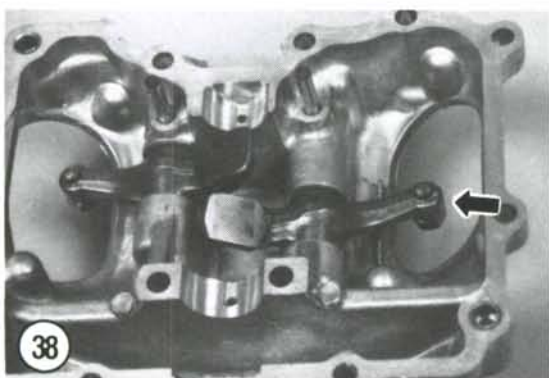
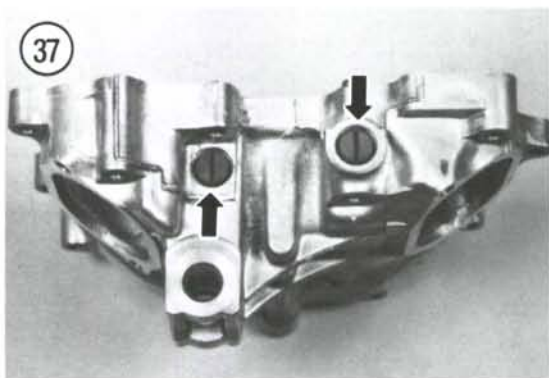
12. Repeat Steps 1-11 for the other rocker arm assembly.

Camshaft and Cylinder Head Cover Installation

1. Lubricate the camshaft bearing journals and bearing surfaces in the cylinder head cover and cylinder head with molybdenum disulfide grease.

NOTE

Step 2 is only necessary if the crankshaft has been rotated since the camshaft was removed.



CAUTION

When rotating the crankshaft, keep the camshaft chain taut and engaged with the crankshaft timing sprocket.

2A. On 2-wheel drive models, perform the following:

- Remove the timing hole cap (A, **Figure 19**) on the left-hand crankcase cover.
- Remove the crankshaft hole cap (B, **Figure 19**) on the left-hand crankcase cover.
- Rotate the crankshaft *clockwise* until the "T" timing mark aligns with the fixed index mark on the crankcase cover (**Figure 20**).

2B. On 4-wheel drive models, perform the following:

- Remove the timing inspection hole cap (A, **Figure 21**).
- Remove the reduction shaft hole cap (B, **Figure 21**).
- Use a 6 mm Allen wrench and rotate the reduction shaft *counterclockwise* until the "T" timing mark aligns with the fixed index mark on the crankcase cover (**Figure 20**).

3. Make sure all sealant residue is removed from the sealing surfaces of both the cylinder head and the cylinder head cover. Spray both sealing surfaces with contact cleaner and wipe clean.

4. Install the camshaft through the camshaft chain and into position in the cylinder head. Locate the camshaft with the cam lobes facing down (C, **Figure 25**).

5. Install and position the camshaft sprocket (B, **Figure 25**) and align the timing marks (**Figure 39**) with the top surface of the cylinder head.

6. Make sure the camshaft chain (A, **Figure 25**) is meshed properly with the crankshaft timing sprocket.

CAUTION

Very expensive damage could result from improper camshaft and camshaft chain alignment. Recheck your work several times to make sure alignment is correct.

7. Pull the camshaft chain up and onto the camshaft sprocket and install the sprocket and camshaft chain onto the shoulder of the camshaft. Make sure the timing marks still align with the top surface of the cylinder head (**Figure 39**). If necessary, reposition the camshaft chain onto the sprocket.

8. Install the camshaft sprocket bolt into the exposed sprocket hole and tighten the bolt to the torque specification listed in **Table 2**.

9. Again rotate the engine in the correct direction (as noted in Step 2) until the other camshaft sprocket bolt is exposed. Install the sprocket bolt and tighten to the torque specification listed in **Table 2**.

10. Make sure the camshaft end cap (A, **Figure 40**) is installed.

11. Make one final check to make sure the alignment is correct. The "T" timing mark must be aligned with the stationary pointer on the left-hand crankcase cover (**Figure 20**) and the alignment marks on the camshaft sprocket are aligned with the top surface of the cylinder head (**Figure 39**). If alignment is not correct, readjust prior to proceeding any further.

12. Make sure the locating dowels (B, **Figure 40**) are in place in the cylinder head.

13. Fill the oil pocket in the cylinder head with fresh engine oil (**Figure 41**) so the cam lobes will be covered for the initial engine start up.

14. Install a new camshaft chain tensioner assembly gasket (**Figure 42**) on the cylinder and install the tensioner as described in this chapter. Tighten the mounting bolts securely.

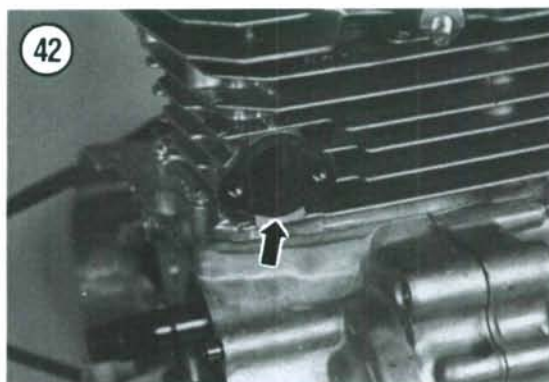
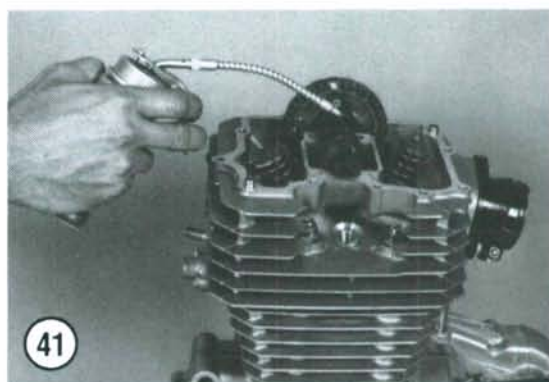
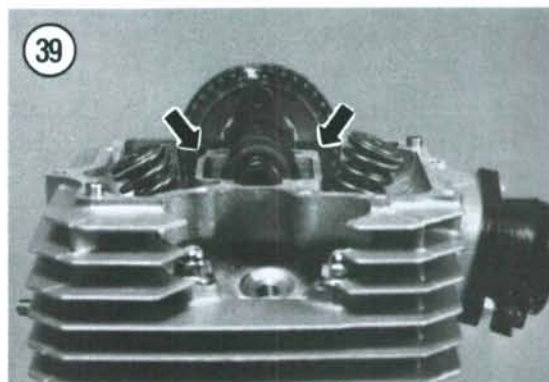
15. Loosen both valve adjusters completely in the cylinder head cover. This is to relieve strain on the rocker arms and cylinder head cover during installation.

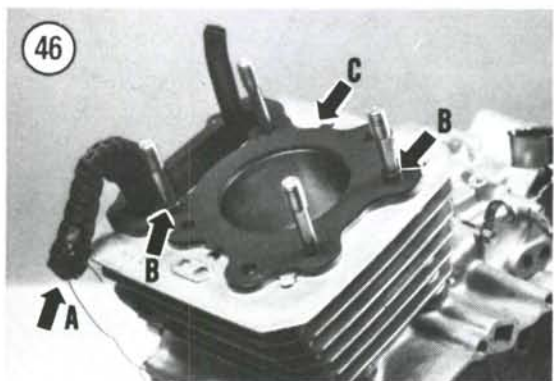
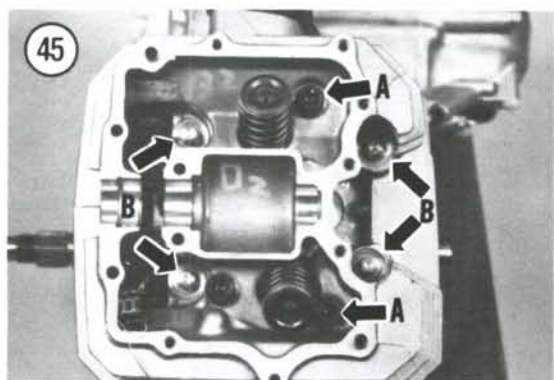
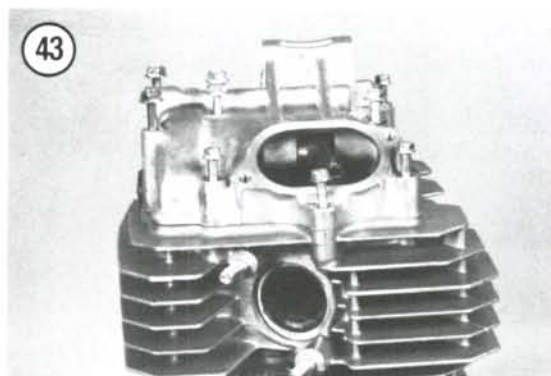
16. Apply a thin even coat of Three Bond 1104 liquid gasket, or equivalent, to the cylinder head cover sealing surface. Do not apply the sealant too close to the edge of the camshaft 3 bearing surfaces as it will restrict oil flow.

17. Install the cylinder head cover bolts. Do not start to screw them in, let them sit on the threaded hole in the cylinder head. The bolt heads should stick up the same amount (**Figure 43**) from the cylinder head surface at all the various locations, if not, the bolts are in the wrong location. Interchange the bolts until all are in the proper location. Be sure to install the copper washer under the correct bolt as shown in B, **Figure 22**). There will be an oil leak if the copper washer is not installed.

18. Tighten the cylinder head cover bolts in 2-3 stages in a criss cross pattern. Tighten to the torque specifications listed in **Table 2**.

19. Inspect the O-ring seal (**Figure 44**) on the valve adjuster covers, replace if necessary. Install the valve adjuster covers and tighten the bolts securely.





20. Refill the engine with the recommended type and quantity of engine oil as described in Chapter Three.

CYLINDER HEAD

Removal/Installation

CAUTION

To prevent any warpage and damage, remove the cylinder head only when the engine is at room temperature.

1. Remove the cylinder head cover and camshaft as described in this chapter.
2. Remove the exhaust system as described in Chapter Seven.
3. Loosen in a criss cross pattern in 2-3 stages, the Allen bolts and copper washers (A, **Figure 45**) and the cap nuts and steel washers (B, **Figure 45**).
4. Remove the bolts and nuts loosened in Step 2.
5. Loosen the cylinder head by tapping around the perimeter with a rubber or soft-faced mallet. If necessary, *gently* pry the head loose with a broad-tipped screwdriver.

CAUTION

Remember the cooling fins are fragile and may be damaged if tapped or pried on too hard. Never use a metal hammer.

6. Untie the wire securing the camshaft chain and retie the wire to the cylinder head.
7. Lift the cylinder head straight up and off the crankcase studs. Guide the cam chain through the opening in the cylinder head and retie the wire to the exterior of the engine (A, **Figure 46**). This will prevent the drive chain from falling down into the crankcase.
8. Remove the cylinder head gasket and discard it. Don't lose the locating dowels.
9. Place a clean shop cloth into the cam chain opening in the cylinder to prevent the entry of foreign matter.
10. Install by reversing these removal steps while noting the following.
11. If removed, install the locating dowels (B, **Figure 46**) in the cylinder head.
12. Install a new head gasket (C, **Figure 46**).
13. Install the cylinder head onto the crankcase studs. With your fingers, carefully insert the cam chain into the cam chain cavity on the side of the

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